WEATHER, FORECASTS, AND WARNINGS FOR THE MONTH.

By Prof. H. C. FRANKENFIELD, in charge of Forecast Division.

The month opened with comparatively settled weather over the European and Asiatic areas and high barometric pressure over middle and southern latitudes of the Atlantic and Pacific oceans. In the United States a barometric depression extended from the Ohio Valley over the southern Rockies and an extensive area of high barometer and low temperature covered the Northwest. Snow was falling in the middle Rocky Mountain States and thunderstorms were reported from the middle Mississippi Valley, over the Ohio Valley, and southern Lake region. On Sunday, May 1, the following special forecast was issued:

In the United States the first half of the present week will be cool in middle and northern districts, and the frost line is likely to extend over the lower Missouri, middle Mississippi, and Ohio valleys. The weather of this period will be unsettled in middle districts from the central valleys eastward, but precipitation will hardly extend over extreme southern States. Over the western portion of the country the weather will be comparatively settled until the latter portion of the week when a disturbance of moderate strength will appear in that region and move thence eastward preceded by rising temperature and attended by showers. A disturbance of more marked intensity will cross the country from about May 9 to 13.

During the first four days of the week the central valleys depression moved eastward to the middle Atlantic coast, attended by showers in middle and northern districts, snow in the middle Plains States, and excessive rains in portions of Missouri and eastern Kansas, and the northwestern high area advanced over the Lake region and central valleys, attended by frost in the lower Missouri, middle Mississippi, and Ohio valleys and the Middle Atlantic States. On the 2d, storm warnings were issued for the Great Lakes and, beginning that date, frost warnings were issued for districts in which frost subsequently occurred.

The Long Branch (N. J.) Herald, of May 7, comments as follows regarding the frost warnings issued for that section:

The frost warnings Thursday saved, in potatoes alone, thousands of dollars to farmers in Monmouth County. All of the large farmers and some of the smaller ones are connected by telephone. Acting upon Weather Bureau advices, farmers covered their potatoes with light soil, many working half the night to preserve their crops. Many acres were thus saved. Those left uncovered were black with frost and will have to be replanted.

On the morning of the 4th the following special forecast was issued:

During the next several days fair weather with rising temperature will prevail over the eastern portion of the United States. In the central valleys and Lake region and thence to the Rockies temperature will rise rapidly. An area of showers that will set in over the Rocky Mountain and Plateau districts Thursday will advance over the Plains States Friday, the central valleys and Lakes Saturday and Sunday, and reach the Atlantic seaboard about the beginning of next week Heavy frost will occur to-night in the interior of the North Atlantic States and the Ohio Valley, and light frost on low grounds in the interior of the Middle Atlantic States.

From the 5th, Thursday, to the 9th a barometric depression advanced from the Rockies to the Atlantic coast attended by showers that at many points in the eastern half of the country were heavy. During the middle days of the week freezing temperature occurred in the upper Lake region and frost in the Ohio Valley and Middle Atlantic and New England States. Following the cool weather a general rise in temperature occurred in the central valleys and Eastern States. The morning of the 7th, when the disturbance was central over Missouri, storm warnings were ordered for the southern Lake region.

On Sunday, May 8, the following special bulletin and forecast was issued:

The ranges and distribution of temperature in the United States during the last two weeks have been unparalled in the history of the Weather Bureau. A cool wave during the third decade of April that was attended by freezing temperature to the southern border of Georgia, and by snow in the interior of the east Gulf States, caused incomputable damage to fruit and vegetation in the central valleys and Southern States that in a large degree might have been avoided by a proper appreciation of the timely warnings issued by the Weather Bureau and the employment of approved frost protecting devices. The cool period was closely followed by a warm wave that produced the highest April temperatures on record at points in the north-central States and temperatures that approached the record in middle-interior and middle-eastern States. The warm wave was in turn followed during the first week in May by an extensive and persistent cold area that during three consecutive nights carried the frost line over the middle Mississippi and Ohio valleys and southern portions of the Middle Atlantic States.

Fair weather now prevails over Europe, except on the northwest coasts where rain is reported. The weather is also settled over the Asiatic area, except off the east coast where a disturbance is apparently moving northward. Over the western portion of the North American Continent the weather is fair with exceptionally high barometric pressure over Alaska. Over eastern portions of the United States low barometric pressure is attended by unsettled rainy weather. In middle and northern latitudes of the Northern Hemisphere atmospheric movements of the present week will be more active than during the preceding week.

In the United States the present week will open with rains over the eastern portion of the country. An area of high barometer and low temperature will appear over the northern Rockies Monday, overspread the middle and northern Plains States Tuesday, advance over the central valleys and Lake region Wednesday, and will reach the Atlantic States about Thursday. A disturbance will appear over the Southwest Monday or Tuesday, advance over the Plains States Tuesday and Wednesday, the central valleys and Lake region Wednesday and Thursday, and reach the Atlantic States Friday or Saturday. This disturbance promises to be attended by copious rains and thunderstorms in the central valleys and Eastern States.

During the first half of the week showers continued in the Middle Atlantic and New England States and a depression moved from the Plateau region over Texas and extended thence over the Ohio Valley. In the Northwest pressure rose with temperature falling below freezing in Minnesota and the Dakotas. In southern Kansas and the Southwest temperature rose above 90°. By Thursday morning the center of disturbance had advanced to Virginia with rain in the Ohio Valley and Tennessee and the Middle Atlantic States and the cold, high area had overspread Middle and Northern States east of the Rockies with temperature 8° to 12° below the freezing point in Minnesota and the Dakotas, freezing temperature over the northern Lake region and northern New England, and frost in the southern Lake region and the interior of New York and New England. On the morning of that day frost was forecast for the Ohio Valley, Tennessee, and the interior of the Middle Atlantic States and storm warnings were ordered for the southeast New England coast. Following the eastward advance over the ocean of the Virginia depression frost occurred Thursday night in the Ohio Valley and the interior of the Middle Atlantic States.

These conditions of high pressure, low temperature, and frosts continued until Sunday morning, May 15, the frost line extending into eastern Tennessee and western North Carolina, and frosts also occurred on the following morning in New England, New York, and portions of eastern Pennsylvania. During this period of cool and fair weather over the East, a depression from the West had moved into the Slope region attended by showers that on Monday morning, May 16, had overspread the Rocky Mountain region, the Plains and Gulf States, and the great central valleys, with some snow in Montana and Wyoming. Heavy rains fell in Arkansas, Oklahoma, and eastern Texas. From the Plains States the disturbance moved northeastward over the upper Lakes with increased intensity and better definition, attended by general rains and a temporary rise in temperature over the eastern portion of the country. On the morning of Tuesday, May 17, storm warnings were hoisted on Lakes Superior and Michigan, and during the day on Lakes Huron, Erie, and Ontario, and moderately high westerly winds were general during the night. Closely following this disturbance came another cold, high area from the

Pacific Northwest attended by frosts and freezing temperatures on Monday morning, May 16, over the interior portions of central and northern districts, west of the Rocky Mountains. These conditions were repeated on the following morning, and extended into the Dakotas and the western portions of Nebraska and Kansas. There was a reaction on the following day, Wednesday, May 18, to much higher temperature under the influence of another disturbance from the British Northwest, which by Wednesday night covered the Dakotas and Montana, and then followed a repetition in magnified form of the weather conditions of the first half of the week, namely, general rains over the eastern and southern portions of the country, with heavy downpours over the Southern States, and severe local storms in portions of Oklahoma. In the meantime pressure had risen over the North Atlantic Ocean, and the eastward movement of the western disturbance was therefore greatly retarded. As a result, it did not entirely disappear until Friday, May 28, and during the entire period showery weather continued east of the Mississippi River, except from the upper Lake region southward where the rain ended during Wednesday, May 25. After this disturbance came another moderate high area bringing with it more frosts, the frost line moving eastward until by the morning of Saturday, May 28, it had extended into West Virginia. During this entire rain period low temperature ruled, except in New England and the Middle Atlantic States, on Monday and Tuesday, May 23 and 24. Nearly normal pressure had prevailed over western Europe and low pressure over northern Asia, the western Pacific Ocean, and Alaska. On Sunday, May 22, the following special forecast was issued:

The present week will open with a continuation of the unsettled, showery weather over the eastern portion of the country, but without much rain of consequence over the extreme northern districts. By Wednesday conditions will become more settled and fair weather will predominate during the remainder of the week, but with a tendency toward a reaction at the end. In the West fair weather will prevail during the first half of the week, but in about three days a disturbance should appear on the north Pacific coast. This disturbance will develop eastward attended by more or less cloudiness and some rains over the extreme northwest, reaching the northern Plains States by the end of the week.

After Wednesday, May 25, low pressure of irregular distribution prevailed over the West, with two days of showers over the lower Missouri and lower Arkansas valleys, and temperature began to rise over the extreme West. On the morning of Saturday, May 28, a well-defined storm was central over Manitoba, and rains had set in to the southeastward over the upper Mississippi Valley. On the following morning the storm was central north of Lake Superior, and the rain area had extended over the upper Lake region, the Missouri and middle Mississippi valleys. The following special bulletin and forecast was then issued:

As indicated in the special bulletin issued last Sunday, unsettled, showery, and comparatively cool weather prevailed over the eastern portion of the country during the first half of the week just ended, followed by generally fair weather during the second half, while over the western portion conditions were reversed, except that the weather was fair over the extreme southwest, and that temperature conditions were about the same as over the east. There were frosts Tuesday and Wednesday mornings in the northwest, and Thursday and Friday mornings in portions of the upper Lake region. As forecast, the north Pacific disturbance appeared during the early days of the week, but the extensive high area overlying the eastern portion of the country checked its movement beyond the Plains States.

Over western Europe fair weather with high pressure prevailed until Saturday when a sharp fall in pressure over Iceland and the British Isles inaugurated a period of rainy weather over those sections, with prospect of its extension eastward and southeastward. Over northern Russia and northern Asia pressure distribution indicated a week of unsettled weather.

The building of the middle Atlantic high area, although temporarily suspended over the western ocean, and the depression over Iceland indicate that after showers Monday over the northeastern districts, fair weather will predominate during the coming week over the eastern portion of the country with seasonable temperatures, although cool Monday over the Lake region, and fog may be expected off the New England and Newfoundland coasts. Over the interior western districts also the weather will be generally fair without marked temperature changes, but with occasional local showers early in the week over the extreme Northwest, and a reaction toward unsettled weather near the close of the week over the Northwest, the eastern slope of the Rockies and the central Plains States.

After this bulletin was issued a ridge of moderately high pressure appeared off the Newfoundland coast, so retarding the northeastern low area that the cool and rainy weather persisted from the Lake region eastward until after the middle of the week. This type of pressure distribution is well recognized, although it can not be forecast on account of the absence of telegraphic reports from the far Northeast.

During Sunday and Monday, May 29 and 30, the rain area extended through the lower Lake region, the Ohio Valley, the Middle Atlantic States, and New England, with a marked fall in temperature, and continued in the upper Lake region with some snow along Lake Superior. Once more, as stated in the paragraph immediately preceding, a high area over the North Atlantic Ocean retarded the eastward movement of the low area, and at the end of the month the latter was still central over New England, the depression extending southward through the South Atlantic States and westward through the Lake region and the Ohio Valley, with continued rains and low temperatures over the northern districts. There was also a slight depression with showers on the last two days of the month over the lower Missouri Valley and the west Gulf States. In the West the weather had become more settled, although cool, with frosts probable on the morning of June 1 in the upper Mississippi Valley, Minnesota, and North Dakota. Temperature continued to rise over the extreme West, and on Monday, May 30, the highest temperature of record for the month of May was reached in Arizona and portions of California and Nevada. At Yuma, Ariz., the maximum temperature of 120° was the highest ever recorded in any month at a regular Weather Bureau station.

Attention is invited to the timeliness and accuracy of the frost warnings issued during the month. While of frequent occurrence, none of damaging character occurred without previous notice. These warnings were especially effective in the great fruit sections of Colorado and the Pacific Northwest. Over the latter section, while rains were comparatively frequent, there were many intervals when frost warnings were necessary, and interested parties have stated that with a free and intelligent use of the Weather Bureau observations and forecasts, no failure in the fruit crop of Oregon need ever be feared.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	12	54.2	− 0.4	+14.0	+ 2.8
Middle Atlantic	15	55.9	− 1.5	+11.5	+ 2.3
South Atlantic	10	68.9	− 1.0	+ 4.8	+ 1.0
Florida Peninsula*	8	75.9	0.0	− 1.1	− 0.2
East Gulf	11	70.3	− 2.0	+ 1.3	+ 0.3
West Gulf	10	70.4	− 2.3	+ 3.5	− 0.7
Ohio Valley and Tennessee	13	60.7	− 4.5	+ 3.5	+ 0.7
Lower Lakes	10	53.7	− 3.5	+ 9.2	+ 1.8
Upper Lakes	12	49.0	− 3.2	+14.0	+ 2.8
North Dakota*	9	50.0	− 3.6	+22.5	+ 4.5
Upper Mississippi Valley	14	57.2	− 4.7	+ 9.8	+ 2.0
Missouri Valley	12	57.0	− 5.0	+15.9	+ 3.2
Northern slope	9	53.0	0.0	+19.1	+ 3.8
Middle slope	6	59.5	− 3.4	+13.7	+ 2.7
Southern slope*	7	68.0	− 1.8	+ 7.7	+ 1.5
Southern Plateau*	9	68.0	+ 2.0	+ 9.3	+ 1.9
Middle Plateau*	10	57.6	+ 2.4	+ 7.2	+ 1.4
Northern Plateau*	10	58.0	+ 2.6	+10.3	+ 2.1
North Pacific	7	54.8	+ 1.6	+ 2.8	+ 0.6
Middle Pacific	5	62.2	+ 2.6	+ 2.8	+ 0.6
South Pacific	4	63.9	+ 2.3	+ 8.5	+ 1.7

*Regular Weather Bureau and selected cooperative stations.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	11	2.76	82	− 0.6	− 1.4
Middle Atlantic	15	2.84	80	− 0.7	− 1.5
South Atlantic	11	3.50	92	− 0.3	− 6.8
Florida Peninsula*	8	1.94	49	− 2.0	− 6.0
East Gulf	11	3.47	97	− 0.1	− 7.3
West Gulf	10	5.01	122	+ 0.9	− 3.2
Ohio Valley and Tennessee	13	4.52	125	+ 0.9	− 0.6
Lower Lakes	10	3.38	92	− 0.2	+ 1.1
Upper Lakes	12	2.94	88	− 0.4	− 1.9
North Dakota*	9	0.86	35	− 1.6	− 2.2
Upper Mississippi Valley	15	3.79	90	− 0.4	− 3.0
Missouri Valley	12	4.36	102	+ 0.1	− 3.1
Northern slope	9	1.95	83	− 0.4	− 1.2
Middle slope	6	3.52	92	− 0.3	− 2.6
Southern slope*	7	2.15	52	− 2.0	− 4.2
Southern Plateau*	9	0.07	15	− 0.4	− 1.7
Middle Plateau*	11	0.42	34	− 0.8	− 3.8
Northern Plateau*	10	1.52	136	+ 0.4	− 1.3
North Pacific	7	1.90	73	− 0.7	− 1.0
Middle Pacific	7	0.22	20	− 0.9	− 5.6
South Pacific	4	0.01	2	− 0.6	− 4.9

*Regular Weather Bureau and selected cooperative stations.

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	75	− 3	Missouri Valley	64	− 1
Middle Atlantic	70	− 2	Northern slope	62	+ 4
South Atlantic	70	− 4	Middle slope	67	+ 6
Florida Peninsula	78	+ 2	Southern slope	57	− 4
East Gulf	69	− 2	Southern Plateau	33	+ 1
West Gulf	73	− 2	Middle Plateau	38	− 8
Ohio Valley and Tennessee	67	− 1	Northern Plateau	50	− 6
Lower Lakes	73	+ 2	North Pacific	76	0
Upper Lakes	70	− 2	Middle Pacific	67	+ 1
North Dakota	61	− 1	South Pacific	68	− 1
Upper Mississippi Valley	64	− 4			

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	6 5	+ 1.0	Missouri Valley	5.2	+ 0.1
Middle Atlantic	5.2	+ 0.2	Northern slope	4.7	− 0.8
South Atlantic	4.6	+ 0.1	Middle slope	5.4	+ 0.5
Florida Peninsula	4.2	− 0.2	Southern slope	4 9	+ 0.5
East Gulf	4.8	+ 0.1	Southern Plateau	2.7	0.0
West Gulf	4.9	+ 0.1	Middle Plateau	3.3	− 0.8
Ohio Valley and Tennessee	5.7	+ 0.7	Northern Plateau	4.1	− 1 0
Lower Lakes	5.6	+ 0.2	North Pacific	5.1	− 1.2
Upper Lakes	5.4	− 0.1	Middle Pacific	4.0	0.0
North Dakota	4.8	− 0.7	South Pacific	3.4	− 0.7
Upper Mississippi Valley	5.2	− 0.1			

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Atlanta, Ga.	12	60	nw.	Mount Tamalpais, Cal.	16	54	ne.
Bismarck, N. Dak.	28	50	nw.	Do.	26	68	nw.
Canton, N. Y.	10	50	w.	Do.	27	52	nw.
Chicago, Ill.	2	50	ne.	Do.	29	51	n.
Columbia, S. C.	22	52	sw.	Mount Weather, Va.	3	52	w.
Fort Worth, Tex.	21	50	sw.	North Head, Wash.	26	64	se.
Galveston, Tex.	23	50	w.	Point Reyes Light, Cal.	11	52	nw.
Kansas City, Mo.	16	50	se.	Do.	12	66	nw.
Mount Tamalpais, Cal.	1	57	nw.	Do.	13	78	nw.
Do.	2	54	nw.	Do.	14	64	nw.
Do.	3	52	nw.	Do.	22	50	nw.
Do.	4	50	nw.	Pueblo, Colo.	15	50	se.
Do.	13	50	nw.	Sheridan, Wyo.	15	54	nw.
Do.	15	56	ne.	Southeast Farallon, Cal.	13	58	nw.

RIVERS AND FLOODS.

By Prof. H. C. FRANKENFIELD, in charge River and Flood Division.

There were no floods of consequence during the month, and as a whole conditions were not materially different from those of the preceding month. In some localities excessive short-period rains resulted in sharp rises, but with a few exceptions none were important, and such damage as was reported occurred on May 8 and 9, and appears to have been confined to the rivers of eastern Kansas and western Missouri. Flood stages were barely reached at Ottawa, Kans., on the Marais des Cygnes River and at Brunswick, Mo., on the Grand River, while on the Osage River the crests were a trifle below the flood stages. The rains that caused these rises were very heavy and under ordinary circumstances would have been sufficient to cause severe floods. The failure was due to the antecedent conditions as set forth in the MONTHLY WEATHER REVIEW for April, 1910. Some growing crops along the Marais des Cygnes and upper Neosho rivers were flooded, and railroad traffic somewhat impeded for a short time. The total losses did not exceed a few thousand dollars. Warnings were issued for these rises at the proper time. As these flood waters, with the exception of those from the Neosho River, passed into the Missouri River there was also a decided rise in the latter river east of Kansas City, as well as in the Mississippi River, from the mouth of the Missouri southward, the crest reaching St. Louis on May 10, Cairo, on May 12 and 13, Memphis, on May 15, and New Orleans on May 24. They did not approximate flood stages, however, except in the Missouri River, between Glasgow and Boonville, Mo.

The Illinois River was generally above flood stage with crests of 21 feet at La Salle, Ill., on May 4, 15.6 feet at Peoria, Ill., on May 8, and 12.9 feet at Beardstown, Ill., from May 14 to 19, inclusive, flood stages being at 18, 14, and 12 feet, respectively.

There were two well-marked rises in the Ohio River below the mouth of the Great Kanawha River, but only to medium stages, and as a rule the mean stages were lower than usual for the season of the year.

Nothing of interest occurred along the Cumberland and Tennessee rivers, except a single sharp rise during the last week of the month, caused by the general and heavy rains from May 20 to 25, inclusive.

The heavy rain area also extended westward over the watersheds of the lower Arkansas and lower Red rivers, with consequent marked rises in the rivers, but no flood stages except in the upper Black River of northeastern Arkansas.

The general rains from May 7 to 9, inclusive, were quickly followed by rapid rises in the rivers of the Carolinas, Georgia, and northeastern Alabama, with some flood stages in the smaller streams of South Carolina, but no damage resulted. As a matter of fact the rises were of distinct benefit to water-power interests.

The same conditions prevailed during the third week of the month over the lower Pearl and the Pascagoula rivers of Mississippi, with corresponding advantage to the lumber interests.

Heavy general rains over eastern Texas from May 13 to 23, inclusive, were attended by the usual quick response on the part of the Trinity, Brazos, the lower Colorado, and the Guadalupe rivers, but flood stages were not reached except along the lower Guadalupe River. Following the heavy rains of the latter part of April over the upper Rio Grande watershed came a moderate flood over that portion of the river flowing through southern New Mexico, with crests of 13.3 feet at San Marcial, N. Mex., on May 21, and 15.6 feet at El Paso, Tex., from